

# Quantum Field Theory for Philosophers

(Shortened version of summary)

## Introduction

- 1) QFT as a guide to metaphysics
- 2) Classical concept of Field  
Field v. Particle theory slide (1)
- 3) What do we mean by an individual? - TI
- 4) Field approach to classical particle physics slide (2)

## Quantum Field Theory

Two approaches:

Field Quantization slides (3)(3a)(3b)(3c)

Second quantization slide (4)

Fock space slide 5, 5a

creation / annihilation operators

↓  
'real' field  $\xrightarrow{\text{first quantization}}$  Quantum Field  
repeated S.E.  $\xrightarrow{\text{2nd quantization}}$  slide (7)

## Is Quantum Field same covered in 2 courses (slide 8)

- Respects
- 1) Real field v. complex field
  - 2) Born - classical field limit  
v. Fermi - Particle limit
  - 3) massive fields (non relativistic) v. massless fields
  - 4) Weyl preformal
  - 5) Causality conditions slide (9)  
↳ Spin-Statistics Theorem. (9a)
- But para fields slide (10)

x

A complete harmony between the wave  
and light-quantum descriptions of  
the interaction [between atoms and  
electromagnetic waves]



2.) Creation & annihilation operator in General notation  
slide (11)  
Kalam-Mutakallamun

30 sec 8.) One-particle Quantum No. does not commute  
with  $Q(2,1)$  &  $Q(x)$ .

\* Once done.

35 min 9.) Notes on Free fields slide (12)

cf Bootstrap programme: says theory, QFT  
importance, implications of good 'model'

10.) What do we mean by renormalization?  
E/H. v. says theory renormalization

40 min 11.) The Problem of individuality  
elem. particles do not possess TI  $\rightarrow$  no individuality  
Stat. mechanical argument. slides (13), (14)

Limitation on accessibility of states of TI is assumed.

12.) Indistinguishability Principle slide (15).  
restriction on observables  $\rightarrow$  para-statistics  
" " " "  $\rightarrow$  Bose/Fermi only

Connection between para particles & parafields  
spatio-temporal continuity of trajectory & individuality  
Vacuum, virtual particles

50 min 13.) Vacuum  $N_0 = 0$ , fluctuations on  $Q(2)$  etc

explains Lamb shift etc — Casimir effect  
of extended particle interpretation.

14.) Virtual particles Expand  $|\Phi\rangle = |\Phi\rangle +$  virtual particles  
 $1\psi + 1\psi'$  added in terms of 1st solutions slide (16)